

In the Claims:

A complete listing of claims in the instant application is provided below as follows:

1 1. (Currently amended) A method of processing a digital image,  
2 comprising the steps of:  
3 providing digital data indexed to represent positions of an  
4 image having S spectral bands for simultaneous output on a  
5 display, said digital data being indicative of an intensity value  
6  $I_i(x,y)$  for each position  $(x,y)$  in each i-th spectral band;  
7 ~~— defining a classification of said image based on evaluating~~  
8 features of said image indicative of dynamic range of said image  
9 in each of said S spectral bands to thereby identify a class  
10 associated with said dynamic range;  
11 adjusting said intensity value for said each position in  
12 each i-th spectral band to generate an adjusted intensity value  
13 for said each position in each i-th spectral band in accordance  
14 with

$$\sum_{n=1}^N W_n (\log I_i(x,y) - \log [I_i(x,y) * F_n(x,y)]), i=1, \dots, S$$

15 where S is the number of unique spectral bands included in said  
16 digital data and, for each n,  $W_n$  is a weighting factor and  
17  $F_n(x,y)$  is a unique surround function applied to said each  
18 position  $(x,y)$  and N is the total number of unique surround  
19 functions;

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20 selecting a filter function based on said class, said filter  
21 function so-selected being optimized in terms of offset and gain  
22 for said dynamic range associated with said class; and

23 filtering said adjusted intensity value for said each  
24 position of said image in each of said S spectral bands using a  
25 said filter function based on said classification of said image  
26 so-selected, wherein a filtered intensity value  $R_i(x,y)$  is  
27 defined.

1 2. (Original) A method according to claim 1 wherein each said  
2 unique surround function is a Gaussian function.

1 3. (Original) A method according to claim 2 wherein said  
2 Gaussian function is of the form

$$e^{\frac{-r^2}{c_n^2}}$$

3 satisfying the relationship

$$k_n \iint e^{\frac{-r^2}{c_n^2}} dx dy = 1$$

4 where

$$r = \sqrt{x^2 + y^2}$$

5 and, for each n,  $k_n$  is a normalization constant and  $c_n$  is a  
6 unique constant for each of said N unique surround functions.

1 4. (Original) A method according to claim 1 further comprising  
2 the step of multiplying said filtered intensity value  $R_i(x,y)$  by

$$\log \left[ \frac{B I_i(x,y)}{\sum_{i=1}^S I_i(x,y)} \right]$$

3 to define a color-restored intensity value  $R'_i(x,y)$ , where B is a  
4 constant.

1 5. (Original) A method according to claim 1 wherein said each  
2 position  $(x,y)$  defines a pixel of said display.

1 6. (Original) A method according to claim 1 wherein, for each n,  
2  $W_n=1/N$ .

1 7. (Currently amended) A method according to claim 1 wherein  
2 ~~said step of defining comprises the step of using features of~~  
3 ~~said image comprise~~ image statistics associated with said image  
4 in each of said S spectral bands ~~to select said filter function.~~

1 8. (Original) A method according to claim 7 wherein said image  
2 statistics include brightness and contrast of said image in each  
3 of said S spectral bands.

1 9. (Original) A method according to claim 1 further comprising  
2 the steps of:

3 selecting a maximum intensity value  $V_i(x,y)$  from the group  
4 consisting of said intensity value  $I_i(x,y)$  and said filtered  
5 intensity value  $R_i(x,y)$ ; and

6 displaying an improved image using said maximum intensity  
7 value  $V_i(x,y)$ .

1 10. (Original) A method according to claim 4 further comprising  
2 the steps of:

3 selecting a maximum intensity value  $V_i(x,y)$  from the group  
4 consisting of said intensity value  $I_i(x,y)$  and said color-  
5 restored intensity value  $R'_i(x,y)$ ; and

6 displaying an improved image using said maximum intensity  
7 value  $V_i(x,y)$ .

1 11. (Currently amended) A method of processing a digital image,  
2 comprising the steps of:

3 providing digital data indexed to represent the positions of  
4 a plurality of pixels of a J-row by K-column display, said  
5 digital data being indicative of an intensity value  $I(x,y)$  for  
6 each of said plurality of pixels where x is an index of a  
7 position in the J-th row of said display and y is an index of a  
8 position in the K-th column of said display wherein a JxK image  
9 is defined;

10 evaluating features of said JxK image indicative of dynamic  
11 range of said JxK image to thereby identify a class associated  
12 with said dynamic range;

13 convolving said digital data associated with each of said  
14 plurality of pixels with a function

$$e^{-\frac{r^2}{c^2}}$$

15 to form a discrete convolution value for each of said plurality  
16 of pixels, said function satisfying the relationship

$$k \iint e^{-\frac{r^2}{c^2}} dx dy = 1$$

17 where

$$r = \sqrt{x^2 + y^2}$$

18 k is a normalization constant and c is a constant;

19 converting, for each of said plurality of pixels, said

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20 discrete convolution value into the logarithm domain;  
21 converting, for each of said plurality of pixels, said  
22 intensity value into the logarithm domain;  
23 subtracting, for each of said plurality of pixels, said  
24 discrete convolution value so-converted into the logarithm domain  
25 from said intensity value so-converted into the logarithm domain,  
26 wherein an adjusted intensity value is generated for each of said  
27 plurality of pixels;  
28 selecting a filter function based on said class, said filter  
29 function so-selected being optimized in terms of offset and gain  
30 for said dynamic range associated with said class; and  
31 filtering said adjusted intensity value for each of said  
32 plurality of pixels with a said filter function ~~that is based on~~  
33 ~~dynamic range of said JxK image~~ so-selected, wherein a filtered  
34 intensity value  $R(x,y)$  is defined.

1 12. (Original) A method according to claim 11 wherein the value  
2 of said constant  $c$  is selected to be in the range of  
3 approximately 0.01 to approximately 0.5 of the larger of  $J$  and  $K$ .

1        13. (Original) A method according to claim 11 further comprising  
2        the steps of:  
3                selecting, for each of said plurality of pixels, a maximum  
4        intensity value  $V(x,y)$  from the group consisting of said  
5        intensity value  $I(x,y)$  and said filtered intensity value  $R(x,y)$ ;  
6        and  
7                displaying an improved image using said maximum intensity  
8        value  $V(x,y)$ .

1 14. (Currently amended) A method of processing a digital image,  
2 comprising the steps of:

3 providing digital data indexed to represent the positions of  
4 a plurality of pixels of an J-row by K-column display, said  
5 digital data being indicative of an intensity value  $I_i(x,y)$  for  
6 each i-th spectral band of S spectral bands for each of said  
7 plurality of pixels where x is an index of a position in the J-th  
8 row of said display and y is an index of a position in the K-th  
9 column of said display wherein a  $(J \times K)_i$  image is defined for each  
10 of said S spectral bands and a JxK image is defined across all of  
11 said S spectral bands;

12 ~~— defining a classification of said JxK image based on~~  
13 evaluating features of each said  $(J \times K)_i$  image indicative of  
14 dynamic range of each said  $(J \times K)_i$  image to thereby identify a  
15 class associated with said dynamic range;

16 convolving said digital data associated with each of said  
17 plurality of pixels in each i-th spectral band with a function

$$e^{\frac{-r^2}{c_n^2}}$$

18 for n=2 to N to form N convolution values for each of said  
19 plurality of pixels in each said i-th spectral band, said  
20 function satisfying the relationship

$$k_n \iint e^{\frac{-r^2}{c_n^2}} dx dy = 1$$

21 where

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$$r = \sqrt{x^2 + y^2}$$

and, for each  $n$ ,  $k_n$  is a normalization constant and  $c_n$  is a unique constant;

converting, for each of said plurality of pixels in each said  $i$ -th spectral band, each of said  $N$  convolution values into the logarithm domain;

converting, for each of said plurality of pixels in each said  $i$ -th spectral band, said intensity value into the logarithm domain;

subtracting, for each of said plurality of pixels in each said  $i$ -th spectral band, each of said  $N$  convolution values so-converted into the logarithm domain from said intensity value so-converted into the logarithm domain, wherein an adjusted intensity value is generated for each of said plurality of pixels in each said  $i$ -th spectral band based on each of said  $N$  convolution values;

forming a weighted sum for each of said plurality of pixels in each said  $i$ -th spectral band using said adjusted intensity values;

selecting a filter function based on said class, said filter function so-selected being optimized in terms of offset and gain for said dynamic range associated with said class; and

filtering said weighted sum for each of said plurality of pixels in each said  $i$ -th spectral band with a said filter

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45 ~~function that is based on said classification of said JxK image~~  
46 so-selected, wherein a filtered intensity value  $R_i(x,y)$  is  
47 defined.

1 15. (Original) A method according to claim 14 wherein the value  
2 for each said unique constant  $c_n$  is selected to be in the range  
3 of approximately 0.01 to approximately 0.5 of the larger of J and  
4 K.

1 16. (Original) A method according to claim 14 further comprising  
2 the step of multiplying said filtered intensity value  $R_i(x,y)$  by

$$\log \left[ \frac{B I_i(x,y)}{\sum_{i=1}^S I_i(x,y)} \right]$$

3 to define a color-restored intensity value  $R'_i(x,y)$ , where B is a  
4 constant and S is a whole number greater than or equal to 2.

1 17. (Currently amended) A method according to claim 14 wherein  
2 said ~~step of defining comprises the step of using~~ features of  
3 said  $(JxK)_i$  image comprise image statistics associated with each  
4 said  $(JxK)_i$  image ~~to select said filter function.~~

1 18. (Original) A method according to claim 17 wherein said image  
2 statistics include brightness and contrast of each said  $(JxK)_i$

3 image.

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1 19. (Original) A method according to claim 14 further comprising  
2 the steps of:

3 selecting a maximum intensity value  $V_i(x,y)$  from the group  
4 consisting of said intensity value  $I_i(x,y)$  and said filtered  
5 intensity value  $R_i(x,y)$ ; and

6 displaying an improved image using said maximum intensity  
7 value  $V_i(x,y)$ .

1 20. (Original) A method according to claim 16 further comprising  
2 the steps of:

3 selecting a maximum intensity value  $V_i(x,y)$  from the group  
4 consisting of said intensity value  $I_i(x,y)$  and said color-  
5 restored intensity value  $R'_i(x,y)$ ; and

6 displaying an improved image using said maximum intensity  
7 value  $V_i(x,y)$ .

21. (Currently amended) A method of processing a digital image,  
comprising the steps of:

providing digital data indexed to represent positions of an  
image having S spectral bands for simultaneous output on a  
display, said digital data being indicative of an intensity value  
 $I_i(x,y)$  for each position  $(x,y)$  in each i-th spectral band;

~~—defining a classification of said image based on evaluating~~  
features of said image indicative of dynamic range of said image  
in each of said S spectral bands to thereby identify a class  
associated with said dynamic range;

adjusting said intensity value for said each position in  
each i-th spectral band to generate an adjusted intensity value  
for said each position in each i-th spectral band in accordance  
with

$$\sum_{n=1}^N W_n (\log I_i(x,y) - \log [I_i(x,y) * F_n(x,y)]), i=1, \dots, S$$

where S is a whole number greater than or equal to 2 and defines  
the total number of spectral bands included in said digital data  
and, for each n,  $W_n$  is a weighting factor and  $F_n(x,y)$  is a unique  
surround function of the form

$$e^{-\frac{r^2}{c_n^2}}$$

satisfying the relationship

$$k_n \iint e^{-\frac{r^2}{c_n^2}} dx dy = 1$$

20 where

$$r = \sqrt{x^2 + y^2}$$

21 and, for each  $n$ ,  $k_n$  is a normalization constant and  $c_n$  is a  
22 unique constant where  $N$  is the total number of unique surround  
23 functions;

24 selecting a filter function based on said class, said filter  
25 function so-selected being optimized in terms of offset and gain  
26 for said dynamic range associated with said class;

27 filtering said adjusted intensity value for said each  
28 position in each  $i$ -th spectral band with a said function ~~based on~~  
29 ~~said classification of said image~~ so-selected wherein a filtered  
30 intensity value  $R_i(x,y)$  is defined; and

31 multiplying said filtered intensity value  $R_i(x,y)$  by

$$\log \left[ \frac{B I_i(x,y)}{\sum_{i=1}^s I_i(x,y)} \right]$$

32 to define a color-restored intensity value  $R'_i(x,y)$ , where  $B$  is a  
33 constant.

1 22. (Original) A method according to claim 21 wherein, for each  
2  $n$ ,  $W_n = 1/N$ .

1 23. (Original) A method according to claim 21 wherein the value  
2 for each said unique constant  $c_n$  is selected to be in the range  
3 of approximately 0.01 to approximately 0.5 of the larger of J and  
4 K.

1 24. (Currently amended) A method according to claim 21 wherein  
2 ~~said step of defining comprises the step of using~~ features of  
3 said image comprise image statistics associated with said image  
4 in each of said S spectral bands ~~to select said filter function.~~

1 25. (Original) A method according to claim 24 wherein said image  
2 statistics include brightness and contrast of said image in each  
3 of said S spectral bands.

1 26. (Original) A method according to claim 21 further comprising  
2 the steps of:

3 selecting a maximum intensity value  $V_i(x,y)$  from the group  
4 consisting of said intensity value  $I_i(x,y)$  and said color-  
5 restored intensity value  $R'_i(x,y)$ ; and

6 displaying an improved image using said maximum intensity  
7 value  $V_i(x,y)$ .